LISTING OF THE CLAIMS INCLUDING AMENDMENTS THERETO

Claims 1–10 Cancelled

11. (Presently Amended) In a system, a method of operation comprising:

receiving a plurality of signals wireless transmitted by a plurality of signal sources, employing a plurality of sensors;

determining a direction of arrival for a first of the signals;

determining a first plurality of directions of arrival for a first plurality of multipaths of a first of the signals, including searching for the first plurality of directions of arrival for the first plurality of multipaths of the first signal in a direction range centered on the determined direction of arrival of the first signal; and

obtaining the first ~~received~~ signal based at least in part on the determined first plurality of directions of arrival for the first plurality of multipaths of the first signal.

12. (Cancelled)

13. (Presently amended) The method of claim 11, wherein

the method further comprises determining a correlation matrix for the signals, and determining a plurality of eigenvectors of the correlation matrix corresponding to the signals; and

said determining of ~~the second plurality of directions of arrivals for the signals, including~~ the direction of arrival of the first signal~~,~~ is performed based at least in part on the determined eigenvectors of the correlation matrix corresponding to the signals.

14. (Original) The method of claim 13, wherein said determining of the correlation matrix comprises averaging a plurality of sets of outer-products of a plurality of signal plus noise

vectors determined based on a plurality of corresponding snapshots of the signals sensed by the sensors.

15. (Original) The method of claim 11, wherein

said receiving of a plurality of signals comprises receiving *J* signals wirelessly transmitted by *J* signal sources, employing N sensors, where *J* and N are integers, each greater than 1;

the *j*th transmitted signal is modeled as $x_j(t) = s_j(t)e^{j(2\pi(2+\varphi_0))}$, $s(t)$ being a base band signal, and φ_0 being an initial phase; and

the received *j*th signal is given by $\mathbf{x}_j(t) = \sum_{l=1}^{L} R_{jl} e^{i2\pi(f_d \cos\theta_{jl} - f\tau_{jl})} s(t-\tau_{jl})$

where *Rjl* is the signal strength of the *l*'th multipath of the *j*'th signal,

$f_d Cos\theta_{jl}$ is a Doppler shift the *l*'th multipath of the *j*'th signal,

f is a carrier frequency,

$s()$ is a base band signal,

$\tau_{jl} = r_{jl}/c$ is a time delay of the *l*'th multipath of the *j*'th signal,

r_{jl} is a range of the *l*'th multipath of the *j*'th signal,

c is speed of Electromagnetic wave, and

θ_{jl} is the direction of arrival of the *l*'th multipath of the *j*'th signal.

16. (Original) The method of claim 15, wherein

a response vector at the N sensor for a signal impinging from an angle θ is given by $\mathbf{v}(\theta_{jl}) = [\,1 \quad e^{\frac{-i2\pi Cos\theta_{jl}}{\lambda}} \quad e^{\frac{i4\pi Cos\theta_{jl}}{\lambda}} \quad \ldots\ldots \quad e^{\frac{i2\pi(N-1)Cos\theta_{jl}}{\lambda}}\,]^T$; and

a baseband signal vector corresponding to the l'th multipath of the j'th signal impinging from an angle θ_{jl} is given by

$$\mathbf{x}_j(t) = \sum_{l=1}^{L} \mathbf{v}(\theta_{jl}) R_{jl} e^{i2\pi(f_d cos\theta_{jl} - f\tau_{jl})} s(t - \tau_{jl})$$

17. (Original) The method of claim 16, wherein said searching comprises computing for a search vector $\{\mathbf{v}(\theta_{jk_1}), \mathbf{v}(\theta_{jk_2}), \ldots, \mathbf{v}(\theta_{jk_L})\}$, θ_{jk_l} being a search angle,

$$r_{11} = \| \mathbf{v}(\theta_{jk_1}) \|_2 \text{ and}$$

$$\mathbf{q}_1 = \frac{\mathbf{v}(\theta_{jk_1})}{r_{11}}$$

$\|.\|_2$ is the 2-norm of the vector.

18. (Original) The method of claim 17, wherein said searching further comprises computing

$$r_{il} = \mathbf{q}_i^H \mathbf{v}(\theta_{jk_l}); \qquad 1 \le i \le l-1; \qquad l = 2,\ldots,L+1$$

$$r_{ll} = \| \mathbf{v}(\theta_{jk_l}) - \sum_{i=1}^{l-1} r_{il}\mathbf{q}_i \|_2, \quad l = 2,\ldots,L+1, \text{ and}$$

$$\mathbf{q}_l = [\mathbf{v}(\theta_{jk_l}) - \sum_{i=1}^{l-1} r_{il}\mathbf{q}_i]/r_{ll}, \quad l = 2,\ldots,L+1.$$

19. (Original) The method of claim 18, wherein said searching further comprises determining whether a function $B(\Theta_j) = \frac{1}{r_{L+1,L+1}}$ yields a peak value, and if so, setting $\Theta_j = \{\theta_{j1},\ldots,\theta_{jL}\}$ as the first directions of arrival of the first plurality of multipaths of the first signal.

20. (Original) The method of claim 11, wherein said obtaining of the first received signal comprises obtaining $z(t)$ based on the determined directions of arrival of L-multipaths of the first received signal as follows

$$z(t) = \sum_{l=1}^{L}\sum_{n=1}^{N} x_n w_{nl} \quad \text{where } w_{nl} = e^{-ikd(n-1)\cos\hat{\theta}_{jl}}$$

21 – 30 Cancelled

31. (Presently Amended) An apparatus comprising:

storage medium having a plurality of programming instructions designed to enable the apparatus to

determine a direction of arrival for a first of a plurality of signals received employing a plurality of sensors, the signals being wirelessly transmitted by a plurality of signal sources, and,

determine a first plurality of directions of arrival for a first plurality of multipaths of a first of thea plurality of signals ~~wireless transmitted by a plurality of signal sources, and received employing a plurality of sensors~~, including searching for the first plurality of directions of arrival for the first plurality of multipaths of the first signal in a direction range centered on the determined direction of arrival of the first signal, and

obtain the first received signal based at least in part on the determined ~~first~~ second plurality of directions of arrival for the first plurality of multipaths of the first signal; and

at least one processor coupled to the storage medium to execute the programming instructions.

32. Cancelled

33. (Presently Amended) The apparatus of claim 31, wherein

the programming instructions are further designed to enable the apparatus to determine a correlation matrix for the signals, and determine a plurality of eigenvectors of the correlation matrix corresponding to the signals; and

the programming instructions are designed to perform said determining of ~~the second plurality of directions of arrivals for the signals, including~~ the direction of arrival of the first signal, based at least in part on the determined eigenvectors of the correlation matrix corresponding to the signals.

34. (Original) The apparatus of claim 33, wherein the programming instructions are designed to perform said determining of the correlation matrix by averaging a plurality of sets of outer-products of a plurality of signal plus noise vectors determined based on a plurality of corresponding snapshots of the signals sensed by the sensors.

35. (Original) The apparatus of claim 31, wherein

said receiving of a plurality of signals comprises receiving *J* signals wirelessly transmitted by *J* signal sources, employing N sensors, where *J* and N are integers, each greater than 1;

the *j*th transmitted signal is modeled as $x_j(t) = s_j(t)e^{j(2\pi(2+\varphi_0))}$, $s(t)$ being a base band signal, and φ_0 being an initial phase; and

the received *j*th signal is given by $\mathbf{x}_j(t) = \sum_{l=1}^{L} R_{jl} e^{i2\pi(f_d \cos\theta_{jl} - f\tau_{jl})} s(t - \tau_{jl})$

where *Rjl* is the signal strength of the *l*'th multipath of the *j*'th signal,

$f_d Cos\theta_{jl}$ is a Doppler shift the *l*'th multipath of the *j*'th signal,

f is a carrier frequency,

$s()$ is a base band signal,

$\tau_{jl} = r_{jl}/c$ is a time delay of the *l*'th multipath of the *j*'th signal,

r_{jl} is a range of the *l*'th multipath of the *j*'th signal,

c is speed of Electromagnetic wave, and

θ_{jl} is the direction of arrival of the l'th multipath of the j'th signal.

36. (Original) The apparatus of claim 35, wherein

a response vector at the N sensor for a signal impinging from an angle θ is given by $\mathbf{v}(\theta_{jl}) = [\,1 \quad e^{\frac{-i2\pi Cos\theta_{jl}}{\lambda}} \quad e^{\frac{i4\pi Cos\theta_{jl}}{\lambda}} \quad \ldots\ldots \quad e^{\frac{i2\pi(N-1)Cos\theta_{jl}}{\lambda}}\,]^T$; and

a baseband signal vector corresponding to the l'th multipath of the j'th signal impinging from an angle θ_{jl} is given by

$$\mathbf{x}_j(t) = \sum_{l=1}^{L} \mathbf{v}(\theta_{jl}) R_{jl} e^{i2\pi(f_d cos\theta_{jl} - ft_{jl})} s(t - \tau_{jl})$$

37. (Original) The apparatus of claim 36, wherein the programming instructions are designed to perform as part of said searching, computation for a search vector $\{\mathbf{v}(\theta_{jk_1}), \mathbf{v}(\theta_{jk_2}), \ldots, \mathbf{v}(\theta_{jk_L})\}$, θ_{jk_l} being a search angle,

$$r_{11} = \| \mathbf{v}(\theta_{jk_1}) \|_2 \text{ and}$$

$$\mathbf{q}_1 = \frac{\mathbf{v}(\theta_{jk_1})}{r_{11}}$$

$\|.\|_2$ is the 2-norm of the vector.

38. (Original) The apparatus of claim 37, wherein the programming instructions are designed to perform as part of said searching, computation of

$$r_{il} = \mathbf{q}_i^H \mathbf{v}(\theta_{jk_l}); \qquad 1 \le i \le l-1; \qquad l = 2,\ldots,L+1$$

$$r_{ll} = \| \mathbf{v}(\theta_{jk_l}) - \sum_{i=1}^{l-1} r_{il}\mathbf{q}_i \|_2, \quad l = 2,\ldots,L+1, \text{ and}$$

$$\mathbf{q}_l = [\mathbf{v}(\theta_{jk_l}) - \sum_{i=1}^{l-1} r_{il}\mathbf{q}_i]/r_{ll}, \quad l = 2,\ldots,L+1.$$

39. (Presently Amended) The apparatus of claim 38, wherein the programming instructions are designed to perform as part of said searching, determination of whether a function $B(\Theta_j) = \frac{1}{r_{L+1,L+1}}$ yields a peak value, and if so, set $\Theta_j = \{\theta_{j1},...,\theta_{jL}\}$ as the first directions of arrival of the first plurality of multipaths of the first signal.

40. (Original) The apparatus of claim 31, wherein the programming instructions are designed to perform said obtaining of the first received signal by obtaining $z(t)$ based on the determined directions of arrival of L-multipaths of the first received signal as follows

$$z(t) = \sum_{l=1}^{L}\sum_{n=1}^{N} x_n w_{nl} \quad \text{where } w_{nl} = e^{-ikd(n-1)\cos\hat{\theta}_{jl}}$$

41-44 Cancelled

45. (Presently amended) A system comprising:

a plurality of antennas to receive a plurality of signals wirelessly transmitted by a plurality of signal sources;

a RF unit coupled to the antennas to down convert the received signals; and

a direction of arrival estimation unit coupled to the RF unit, to

determine a direction of arrival for a first of a plurality of received signals wireless transmitted by a plurality of signal sources,

determine a first plurality of directions of arrival for a first plurality of multipaths of a first of thea plurality of ~~received~~ signals ~~wireless transmitted by a plurality of signal sources~~, including searching for the first plurality of directions of arrival for the first plurality of multipaths of

the first signal in a direction range centered on the determined direction of arrival of the first signal, and

obtain the first ~~received~~ signal based at least in part on the determined first plurality of directions of arrival for the first plurality of multipaths of the first signal.

46. Cancelled

47. (Presently Amended) The system of claim 45, wherein the direction of arrival estimation unit further

determines a correlation matrix for the signals, and determines a plurality of eigenvectors of the correlation matrix corresponding to the signals; and

determines the ~~second plurality of directions of arrivals for the signals, including~~ the direction of arrival of the first signal, based at least in part on the determined eigenvectors of the correlation matrix corresponding to the signals.

48. (Original) The system of claim 47, wherein the direction of arrival estimation unit determines the correlation matrix by averaging a plurality of sets of outer-products of a plurality of signal plus noise vectors determined based on a plurality of corresponding snapshots of the received signals.

49-50 Cancelled.

51. (Presently Amended) An article of manufacture, comprising

a machine readable medium having stored therein a plurality of programming instructions designed to enable an apparatus to

determine a direction of arrival for a first of a plurality of signals wireless transmitted by a plurality of signal sources,

determine a first plurality of directions of arrival for a first plurality of multipaths of a first of thea plurality of ~~received~~ signals ~~wireless transmitted by a plurality of signal sources~~, including searching for the first plurality of directions of arrival for the first plurality of multipaths of the first signal in a direction range centered on the determined direction of arrival of the first signal, and

obtain the first ~~received~~ signal based at least in part on the determined ~~first~~ second plurality of directions of arrival for the first plurality of multipaths of the first signal.

52. Cancelled.